



# Effects of music stimulus on behavior response, cortisol level and immunity horizontal of growing pigs

Jia-fang Li, Qian Han, Run-xiang Zhang, Hong-gui Liu, Xiang Li, Jun Bao\*  
College of Animal Science and Technology, Northeast Agricultural University

## Abstract

Enrichment environment is widely used to improve the welfare of domestic animals and satisfy their natural behavior. Music as an enriched environment can reduce abnormal behavior in humans, non-human primates and rodents. The aim of this study was to investigate the effects of repeated music stimuli on the behavior, physiology and immunity of growing pigs.

## Results

### 1. The results of music and noise on the behavior of growing pigs

	Music	Noise	Control	F <sub>2,21</sub>	P values
State behavior (%)					
Lying	80.83 <sup>a</sup> ±0.76	82.21 <sup>b</sup> ±0.37	85.18 <sup>a</sup> ±0.65	13.06	<0.001
Ventral lying	47.10±1.41	48.13±0.92	49.43±1.19	0.97	0.396
Lateral lying	33.74±1.29	34.08±0.96	35.87±1.09	0.23	0.799
Active	19.17 <sup>a</sup> ±0.76	17.79 <sup>a</sup> ±0.37	14.82 <sup>b</sup> ±0.65	13.06	<0.001
Standing	14.68 <sup>a</sup> ±0.56	13.81 <sup>a</sup> ±0.73	12.27 <sup>b</sup> ±0.56	6.52	0.006
Walking	4.49 <sup>a</sup> ±0.24	3.42 <sup>b</sup> ±0.20	2.55 <sup>b</sup> ±0.16	23.45	<0.001
Event behavior (n)					
Tail wagging	111.38 <sup>a</sup> ±22.72	15.50 <sup>b</sup> ±2.82	33.13 <sup>b</sup> ±4.25	14.41	<0.001
Playing behavior	67.88 <sup>a</sup> ±4.63	36.25 <sup>a</sup> ±2.01	32.75 <sup>b</sup> ±1.81	39.07	<0.001
Manipulating behavior	64.75±7.00	62.75±2.20	70.50±5.25	0.25	0.784
Exploring behavior	467.63 <sup>a</sup> ±16.35	457.38 <sup>a</sup> ±9.45	350.13 <sup>b</sup> ±11.06	26.54	<0.001
Aggressive behavior	25.88 <sup>a</sup> ±3.66	53.13 <sup>a</sup> ±1.99	26.25 <sup>b</sup> ±2.27	32.57	<0.001

The results of table 1 showed that lying behavior in the music and noise groups was significantly lower than the control group ( $P < 0.001$ ), while their standing ( $P < 0.05$ ) and walking behavior ( $P < 0.05$ ) was significantly higher than the control group. The frequency of playing behavior, tail wagging in the music group was significantly higher than the noise and control groups ( $P < 0.001$ ). The pigs in the music and noise group showed more exploring behaviors than the control group ( $P < 0.001$ ). The aggressive behavior in the noise group was significantly higher than the control and music group ( $P < 0.001$ ).

### 2. The results of music and noise on cortisol levels in growing pigs

	Treatment	Day		
		D4	D28	D60
Serum cortisol (ng/L)	Music	34.60 <sup>a</sup> ±1.73	34.52 <sup>a</sup> ±1.73	37.22±1.73
	Noise	44.04 <sup>b</sup> ±1.73	35.47 <sup>b</sup> ±1.73	37.03 <sup>b</sup> ±1.73
	Control	43.95 <sup>ab</sup> ±1.73	42.68 <sup>ab</sup> ±1.73	35.62 <sup>a</sup> ±1.73
P <sub>treatment</sub> <0.001, F <sub>2,24</sub> =8.13; P <sub>day</sub> =0.008, F <sub>2,24</sub> =5.61; P <sub>treatment×day</sub> =0.001, F <sub>2,24</sub> =5.61				
Salivary cortisol (ng/L)	Music	39.05 <sup>ab</sup> ±0.27	31.43 <sup>a</sup> ±2.56	26.63 <sup>a</sup> ±1.01
	Noise	45.01 <sup>a</sup> ±0.77	33.94 <sup>a</sup> ±1.83	25.50 <sup>a</sup> ±1.42
	Control	46.36 <sup>a</sup> ±2.07	36.53 <sup>a</sup> ±0.65	27.56 <sup>a</sup> ±0.88
P <sub>treatment</sub> =0.003, F <sub>2,24</sub> =7.04; P <sub>day</sub> <0.001, F <sub>2,24</sub> =101.80; P <sub>treatment×day</sub> =0.149, F <sub>2,24</sub> =1.85				

The results of table 2 showed that Short-term (4d and 8d) music stimulus had a lower cortisol level than the noise and control groups ( $P < 0.05$ ).

### 3. The results of music and noise on immune indexes of growing pigs

	Treatment	Day		
		D4	D28	D60
IL-2 (ng/L)	Music	156.40 <sup>a</sup> ±2.15	170.28 <sup>ab</sup> ±2.15	186.82 <sup>ab</sup> ±1.75
	Noise	158.42±2.15	155.36 <sup>a</sup> ±2.15	163.60±1.75
	Control	159.39 <sup>a</sup> ±2.15	159.99 <sup>ab</sup> ±2.15	169.29 <sup>ab</sup> ±1.75
P <sub>treatment</sub> <0.001, F <sub>2,24</sub> =27.73; P <sub>day</sub> <0.001, F <sub>2,24</sub> =51.38; P <sub>treatment×day</sub> <0.001, F <sub>2,24</sub> =11.77				
IL-4 (ng/L)	Music	33.96 <sup>a</sup> ±1.43	31.75 <sup>ab</sup> ±1.43	25.11 <sup>b</sup> ±1.17
	Noise	35.52±1.43	34.63 <sup>a</sup> ±1.43	33.12±1.17
	Control	32.11±1.43	30.43 <sup>b</sup> ±1.43	31.65 <sup>a</sup> ±1.17
P <sub>treatment</sub> =0.002, F <sub>2,24</sub> =7.63; P <sub>day</sub> =0.003, F <sub>2,24</sub> =7.01; P <sub>treatment×day</sub> =0.013, F <sub>2,24</sub> =3.74				
IFN-γ (ng/L)	Music	92.81 <sup>a</sup> ±2.05	96.03 <sup>ab</sup> ±2.43	103.98 <sup>ab</sup> ±1.80
	Noise	88.78±2.92	89.04 <sup>a</sup> ±2.33	88.08 <sup>a</sup> ±2.39
	Control	87.76±1.28	85.87 <sup>b</sup> ±1.27	86.78 <sup>a</sup> ±1.43
P <sub>treatment</sub> <0.001, F <sub>2,24</sub> =3.74; P <sub>day</sub> =0.180, F <sub>2,24</sub> =1.81; P <sub>treatment×day</sub> =0.065, F <sub>2,24</sub> =2.46				
IgG (ug/mL)	Music	502.77 <sup>ab</sup> ±7.89	472.15 <sup>b</sup> ±7.89	567.32 <sup>a</sup> ±6.44
	Noise	574.41 <sup>a</sup> ±7.89	511.43 <sup>a</sup> ±7.89	545.46 <sup>a</sup> ±6.44
	Control	501.01 <sup>b</sup> ±7.89	479.08 <sup>b</sup> ±7.89	528.02 <sup>ab</sup> ±6.44
P <sub>treatment</sub> <0.001, F <sub>2,24</sub> =2.10; P <sub>day</sub> <0.001, F <sub>2,24</sub> =41.59; P <sub>treatment×day</sub> <0.001, F <sub>2,24</sub> =11.40				

The results of table 3 showed that long-term (60d) music stimulus increased the level of IgG, IL-2 and IFN-γ ( $P < 0.05$ ) and decreased the IL-4 level ( $P < 0.05$ ). Long-term noise stimulus significantly reduced the level of IgG ( $P < 0.05$ ), but did not affect the level of IL-2, IL-4 and IFN-γ ( $P > 0.05$ ).

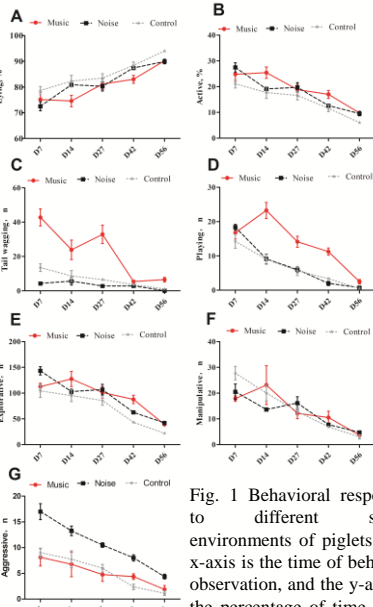


Fig. 1 Behavioral responses to different sound environments of piglets. The x-axis is the time of behavior observation, and the y-axis is the percentage of time spent on behavior or the frequency of the behavior

## Conclusion

Music stimulus triggers the pigs to show more positive behaviors, the music environment increases the activity, tail wagging and playing behavior of the growing pigs, but long-term music stimuli reduce most of the observed behaviors and animals show habituation. And the short-term music stimulus can reduce the stress response, while the long-term music stimulus can enhance the immune responses in the growing pigs.

## Acknowledgments

This work was supported by the earmarked fund for China Agriculture Research System (Grant No. cars-35) and the National Natural Science Foundation of China (Grant No. 31972606).